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(64)Multifocal organic lens with a heterogeneous refractive index

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[Disclosure] Document

1 Title of the invention
A multifocal organic lens with a heterogeneous refractive index

2 Scope of claims
A multifocal organic lens with a heterogeneous refractive index, where an organic substance with a given refractive index is [polymerized] upon either the [distance] or [reading zone] of a multifocal organic lens substrate with a different, homogeneous refractive index.

3 [Detailed] description of the invention
This invention is about multifocal organic lenses used primarily as [glasses for the correction of presbyopia].
The object of the invention is to provide a low-cost multifocal organic lens for which ?? is easy, and optical characteristics are excellent.
[Conventional] multifocal organic lenses [for the correction of presbyopia] include bifocal lens and [progressive multifocal lenses]. Fig.1 and fig.2 are respectively an elevation view and a cross-sectional view showing the shape of a bifocal lens. In the figures, #1 is the zone for distant viewing, and #2 is the zone for close viewing, which are called, respectively, the distance zone and reading zone. The lens material is an organic material with a homogeneous refractive index, and in order to obtain a specific [addition], it is necessary to reduce R2, the radius of curvature for the reading zone with respect to R1, the radius of curvature for the distance zone. As a result, the reading zone takes on a forward protruding shape, as in the figures, and has both the disadvantage of poor esthetics and also, optically, of producing a jump in the visual image at boundary 3. Fig. 3 and fig. 4 are respectively the elevation view and a cross-sectional view based on the principal meridian M-M' showing the shape of a [progressive multifocal lens]. In the figures, #4 is the distance zone, #5 is the reading zone and #6 is the zone for viewing an object at an intermediate distance, which is called the [progressive] zone. As in Fig.4, the shape of the principal meridian M—M' is a circular arc (R2) in which the radius of curvature for distance zone 4 (R1) is lengthened, the radius of curvature for reading zone5 (R2) is shortened, and the radius of curvature for the progressive zone6 (R3), which stretches from the distance zone to the reading zone is [progressively] reduced. With this lens, in comparison against the above-mentioned bifocal lenses, there is no clear division or boundary between the distance zone and the reading zone, so there is no problem with respect to esthetics or visual image jumping at the boundary. [However,] because it is an aspherical curved surface, there is the disadvantage that the polishing of the glass surface for polymerization of the lens is difficult and costly. Also, along with bifocal lenses, [progressive multifocal lens], there is a need for changing the [addition, and particularly the] shape, which also has explains the high cost. This invention eliminates the abovementioned disadvantages of multifocal organic lenses, and provides easy ??, excellent optical characteristics, and a low-cost multifocal organic lens. Below a detailed description of this invention is presented using an actual implementation.

Fig. 6. fig. 6 is one implementation of this invention.

In the figure, #7 is the distance zone、#8 is the reading zone and #9 is the boundary zone. In Fig.6, within the cross section of the lens, the [distribution] of the refractive indices are shown, where A is the homogeneous, low refractive index zone, B is the homogeneous high refractive index zone, and C is the refractive index between A and B, which is a zone in which the refractive index is [progressively] changed, spanning from A to B. Such a distribution of refractive indices [applies] according to, for example, the following type of process. First, using an organic substance with a low refractive index [(Ma)], a lens with a spherical frontal surface is [polymerized] (this is called the lens substrate). At this time, before [polymerization] is completed, the lens substrate, outside of the area intended for the reading zone, is masked, and while an organic material with a high refractive index [(Mb)] is being?-ed, if [polymerization] is [continued], the organic material with a high refractive index from the reading zone's surface is diffused and polymerized. Consequently, there arises a refractive index distribution, with region B, in which diffusion is adequately [completed,] and which has homogeneous high refractive index, region A, where diffusion has not taken place, and where the lens substrate has a low refractive index, and region C, in which the diffusion between the two has progressively completed polymerization. In this manner, using an organic lens with a heterogeneous ??refractive index, it is possible to control the planar refractive index distribution range and the surface? refractive index distribution range, through the conditions of polymerization during diffusion and polymerization, for example the masking procedure, temperature and time. Next, we discuss the optical characteristics of this lens. Fig.7 is an expanded figure of part of the distance zone of the lens, and the symbols are the same as fig.6. First, regarding the [frontal surface?of the lens], the refractive index distribution is N as shown in fig.8(in fig.8, values increase to the right), and from the relation P=([N—t])/R relation, this surface diopter is P, as shown [in the same figure] P. Moreover in regions [7 and 8], the diopter is added to this, due to the cross-sectional refractive index distribution. In short, as shown in fig.7, when the diffusion process is spherically performed, the diopter P'=(Nb—Na)/r, with a spherical surface of 20 for radius r, which has an optically equivalent diopter within the [C region]. As such, diopter [PT] (=P+P'), which is independent of the lens?surface, is as in fig.?. Also, with ???, the diopter which depends on [region] C?? is as in the figure. In this way, with this invention, it is possible to obtain the addition shown in fig.8 PT. This lens is?a [progressive multifocal lens], and with no boundary, and has the features of conventional [progressive multifocal lenses], such as the esthetic aspect and the absence of image jump. Additionally, as is clear from the above description, because it is possible to make the frontal surface spherical, [fabrication of] glass templates using polymerization is also [easy], so decreased costs can be expected. Also, through the conditions during diffusion and polymerization, the range and addition of the distance zone, reading zone and intermediate zone of the lens can freely be altered.

Fig.9 is another implementation of this invention featuring the diffusion and polymerization of organic material with low refractive zone on the distance zone of a lens substrate with a high refractive index. It is evident that this case also obtains similar results to the above-mentioned implementation.

Further, with the above, we have described implementations which diffuse, from the frontal surface, the lens substrate and organic material with different refractive indices, but the same effect is obtained by implementing the same process at the rear surface, which does not fall outside the scope of this invention.

4 Brief description of drawings

Fig.1 and 2 are conventional bifocal organic lenses.
Fig.3 and 4 are conventional [progressive] multifocal organic lenses.
Fig.5, 6 and 7 are implementations of this invention.
Fig.8 is the distribution of refractive indices and diopters for the invented lens.
Fig.9 is another implementation of this invention.

In the figures, the algebraic symbols
1, 4, 7......distance zone
2, 5, 8......reading zone
6, 9......intermediate zone
5......boundary
A......low refractive index region
B......high refractive index region
C......intermediate refractive index region
N......distribution of refractive index
P......distribution of diopter

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